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A BIRD CENSUS OF GARDEN ISLAND, W.A.

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INTRODUCTION

Following the establishment of HMAS *Stirling* on Garden Island, W.A. (32°15'S, 115°41'E), the Australian Department of Defence has taken an active interest in the environmental management of the island. An expression of this interest was the approval given by the Commodore of HMAS *Stirling* for a party from the Western Australian Group of the RAOU to visit the island during the weekend March 17/18, 1979 and survey it as part of the *Atlas of Australian Birds*. So that the data collected could be compared with that obtained by other parties on subsequent visits, a point count census was conducted.

METHODS

Census methods have been well reviewed by Robbins (1978) who indicates that in the northern hemisphere the Indices Ponctuals d'Abondance, IPA, method is acceptable for forest birds in the breeding season but not so good in the non-breeding season because so many birds form nomadic or migratory flocks, greatly increasing the variability of a series of observations. In Western Australia, however, many species hold territories throughout the year and for these species the IPA method can probably be applied, with qualifications, throughout the year. Robbins (1978) indicates that at least two counts are needed. In the present series of observations it was not practical to make two counts at the same place and time on different days, nor, of course, could methods of assessment appropriate to the breeding season be adopted. Some modification of the methods advocated by Ferry and Frochot (1970), therefore, had to be made.

The vegetation of Garden Island has been described by McArthur (1957) and recently McArthur and Bartle (1978) have published a vegetation map of the area. The vegetation is largely unchanged by European settlement and is dominated by *Callitris preissii*, *Acacia rostellifera* and *Melaleuca lanceolata*. The structure of the vegetation is unlike that of the mainland because it usually has only a single layer, shrub and herb layers being very poorly represented in stands of the dominant trees. The island has been isolated from the mainland for at least 4,000 years and perhaps for as long as 100,000 years (McArthur, 1957). Abbott (1980) published a general account of the birds of Garden Island based on several recent visits and reviewed earlier literature.

Garden Island was visited for a day in August, 1978 and a general appreciation of its layout and bird life obtained. On March 17, 1979, seven sites were selected covering the five main vegetation associations on the island.

Table I gives the vegetation type sampled at each site, following the description of McArthur and Bartle (1978). The Australian Map Grid reference for the first of each quadrats at each site is also given, because this grid is printed on McArthur and Bartle's map. At each site six quad-

rats were established, 100 m apart, approximately in a straight line, but usually following roads or tracks. At each quadrat a marker was placed to indicate its centre and a second marker, 30 m due north, visible from the centre, placed to indicate its perimeter. Each quadrat was taken to be a circle of 30 m radius from the marked centre. Observers working in pairs were asked to visit three adjacent quadrats, starting on the first at 0630 hrs on March 18. At each quadrat they were asked to record on a sheet of radial graph paper the species of bird they saw, the numbers and direction of flight and locate these details on the graph paper as if the graph paper was a map of the quadrat. They were asked to use the symbols of the International Bird Census Committee (1969), to spend 20 minutes recording at each quadrat, then walk to the next adjacent quadrat and repeat the procedure until the three quadrats were covered. Except in one case, recording was completed by 0800. Observers were asked to record merely the number they contacted and not to try and evaluate how many individuals were involved.

TABLE 1.—THE VEGETATION ASSOCIATIONS AND GRID REFERENCES OF THE SITES USED DURING THE BIRD CENSUS ON GARDEN ISLAND, W.A. IN MARCH, 1979.

Site	Vegetation Association	AMG Reference
Site 1	<i>Acacia rostellifera</i> - <i>Acacia heteroclita</i> scrub	3(75)420E/64(33)010N
Site 2	<i>Acacia rostellifera</i> scrub	3(75)900E/64(33)500N
Site 3	<i>Acacia rostellifera</i> scrub	3(76)100E/64(34)500N
Site 4	<i>Melaleuca lanceolata</i> forest	3(75)580E/64(36)290N
Site 5	<i>Melaleuca lanceolata</i> - <i>Acacia rostellifera</i> - <i>Callitris preissii</i> scrub	3(74)850E/64(37)810N
Site 6	<i>Callitris preissii</i> - <i>Melaleuca lanceolata</i> forest	3(74)750E/64(38)720N
Site 7	<i>Callitris preissii</i> - <i>Melaleuca lanceolata</i> forest	3(74)500E/64(39)720N

TABLE 2.—RANK ORDER OF ABUNDANCE OF 14 BIRD SPECIES ASSESSED IN FOUR DIFFERENT WAYS DURING STUDIES ON GARDEN ISLAND, W.A. ON MARCH 18, 1979. FOR FULL EXPLANATION, SEE TEXT.

Species	Total	Maximum	Frequency	Atlas
Silvereye	1	1	1	4
Singing Honeyeater	2	6.5	2	1.5
Willie Wagtail	3.5	4	3	4
Grey Butcher-bird	3.5	2	4	7
Grey Fantail	5	5	7	9
Wolcomo Swallow	6	3	8	4
Western Warbler	7	8.5	5.5	11
Golden Whistler	8	10.5	5.5	7
Silver Gull	9	8.5	9.5	1.5
Raven	10	6.5	11.5	7
Laughing Dove	11	10.5	9.5	11
Rufous Whistler	13	13	11.5	13.5
Caspian Tern	14	13	13.5	11
Common Bronzewing	12	13	13.5	13.5

RESULTS

Table 2 presents summaries of the results of this census in several ways, expressed as rankings of the fourteen species observed in the 42 quadrats surveyed on March 18. Three rankings were made from the quadrat data and the fourth from data independently collected.

Total. Shows the rank order given by rating the species from one for that seen in greatest total numbers over all 42 quadrats to 14 for that seen in least total numbers.

Maximum. Shows the rank order given by rating the species from one for that with the highest maximum numbers seen in 20 minutes at a single quadrat to 14 for that seen in lowest maximum numbers in 20 minutes at a single quadrat. This measure is recommended in Robbins' (1978) review.

Frequency. Shows the rank order given by rating the species from one for that seen in most of the 42 quadrat observations to 14 for that seen in least of the 42 quadrat observations. Blondel (1975) has shown that this measure correlates with density measures of breeding birds in France over a substantial range of measurements.

Atlas. 15 of the participants in the study submitted observation sheets to the *Atlas of Australian Birds* based on their sightings made over the whole of Garden Island during the two days 17 and 18 March, 1979. This ranking shows the order given by rating the species from one for that recorded on most of these atlas sheets to 13.5 for that recorded on least. Species, mainly waders and sea birds, not recorded in the quadrat observations were omitted from the ranking in Table 1.

Kendall's Coefficient of Concordance (Siegel, 1956) for these data was +0.806 (X^2 41.94; df 13; $p < 0.001$) showing excellent agreement between the rankings.

TABLE 3.—THE NUMBER OF 30 M RADIUS QUADRATS IN WHICH EACH SPECIES WAS CONTACTED AT LEAST ONCE DURING OBSERVATIONS IN 42 QUADRATS ON GARDEN ISLAND, W.A. ON MARCH 18, 1979. NOTE THAT TWICE AS MANY MEASUREMENTS WERE MADE IN THE ASSOCIATIONS LISTED IN THE LAST TWO COLUMNS AS IN THOSE LISTED IN THE FIRST THREE.

No. of quadrats:	6	6	6	12	12
Vegetation association	<i>A. rostellifera</i> <i>A. heteroclita</i> scrub	<i>M. lanceolata</i> forest.	<i>M. lanceolata</i> <i>A. rostellifera</i> <i>C. preissii</i> scrub.	<i>C. preissii</i> <i>M. lanceolata</i> forest.	<i>A. rostellifera</i> scrub.
Species					
Silvereye	5	6	6	9	10
Willie Wagtail	5	2	4	2	3
Singing Honeyeater	5	1	0	4	9
Grey Fantail	0	1	2	2	2
Golden Whistler	0	1	1	3	3
Western Warbler	0	1	2	3	2
Grey Butcher-bird ..	0	0	3	9	1
Laughing Dove	0	1	1	0	1
Common Bronzewing	0	0	0	1	1
Raven	0	0	0	2	0
Welcome Swallow ..	2	0	0	0	2
Rufous Whistler	0	0	0	0	2
Caspian Tern	1	0	0	0	0
Silver Gull	3	0	0	0	0

Table 3 presents the number of quadrats in which each species was contacted at each of the seven sites during the observations of March 18. Blondel (1975) considers this measure (which he calls frequency) correlates well with density. Differences between the various vegetation associations are apparent but there are insufficient data to test the significance of these differences statistically.

APPENDIX 1

Species recorded on Garden Island, 17-18 March, 1979 with number of Atlas sheets on which each was recorded. Total number of sheets: 15.

Pied Cormorant <i>Phalacrocorax varius</i> ...	13	Laughing Dove <i>Streptopella senegalensis</i> ...	11
Little Pied Cormorant <i>P. melanoleucos</i> ...	12	Common Bronzewing <i>Phaps chalcoptera</i> ...	4
Black Cormorant <i>P. carbo</i> ...	2	Brush Bronzewing <i>P. elegans</i> ...	1
Little Black Cormorant <i>P. sulcirostris</i> ...	3	Red-capped Parrot <i>Purpureicephalus spurius</i> ...	2
White-faced Heron <i>Ardea novaehollandiae</i> ...	2	Port Lincoln Parrot <i>Barnardius zonarius</i> ...	1
Reef Heron <i>Egretta sacra</i> ...	7	Fan-tailed Cuckoo <i>Cacomantis pyrrhophanus</i> ...	3
Osprey <i>Pandion haliaetus</i> ...	10	Sacred Kingfisher <i>Halcyon sancta</i> ...	11
Nankeen Kestrel <i>Falco cenchroides</i> ...	1	Bee-eater <i>Merops ornatus</i> ...	1
Pied Oystercatcher <i>Haematopus ostralegus</i> ...	11	Walcome Swallow <i>Hirundo neoxena</i> ...	14
Sooty Oystercatcher <i>H. fuliginosus</i> ...	1	Tree Martin <i>Petrochelidon nigricans</i> ...	3
Banded Plover <i>Vanallus tricolor</i> ...	10	Pipit <i>Anthus novaeseelandiae</i> ...	9
Grey Plover <i>Pluvialis squatarola</i> ...	11	Golden Whistler <i>Pachycephala pectoralis</i> ...	13
Red-capped Dotterel <i>Charadrius ruficapillus</i> ...	1	Rufous Whistler <i>P. rufiventris</i> ...	4
Turnstone <i>Arenaria interpres</i> ...	9	Grey Fantail <i>Rhipidura fuliginosa</i> ...	12
Whimbrel <i>Numenius phaeopus</i> ...	5	Willie Wagtail <i>R. leucophrys</i> ...	14
Grey-tailed Tattler <i>Tringa brevipes</i> ...	2	Western Warbler <i>Gerygone fusca</i> ...	11
Common Sandpiper <i>T. hypoleucos</i> ...	6	Yellow-rumped Thornbill <i>Acanthiza chrysorrhoa</i> ...	1
Bar-tailed Godwit <i>Limosa lapponica</i> ...	12	Singing Honeyeater <i>Meliphaga virescens</i> ...	15
Great Knot <i>Calidris tenuirostris</i> ...	9	White-fronted Chat <i>Ephthianura albiglans</i> ...	3
Red-necked Stint <i>C. ruficollis</i> ...	4	Silvereye <i>Zosterops gouldi</i> ...	14
Sanderling <i>C. alba</i> ...	4	Maggie Lark <i>Grallina cyanoleuca</i> ...	1
Broad-billed Sandpiper <i>Limicola falcinellus</i> ...	1	Grey Butcherbird <i>Cracticus torquatus</i> ...	13
Silver Gull <i>Larus novaehollandiae</i> ...	15	Australian Raven <i>Corvus coronoides</i> ...	13
Caspian Tern <i>Hydroprogne caspia</i> ...	11		
Fairy Tern <i>Sterna nereis</i> ...	8		
Crested Tern <i>Sterna bergii</i> ...	14		
Domestic Pigeon <i>Columba livia</i> ...	1		

Appendix 1 presents a list of species recorded on Garden Island during the study, together with an indication of the number of Atlas sheets on which they were recorded.

DISCUSSION

The abundance of Silvereyes on the island shown by these results may perhaps be a seasonal phenomenon, a point already made by Abbott (1979) who presents relative abundance figures based on mist netting in early February, 1975. The Silvereye was then less abundant than the Golden Whistler and Singing Honeyeater. For the other species, the results give a comparative estimate of abundance of the main species inhabiting the island, apart from sea birds. An island such as Garden Island is particularly well suited to census methods of this type because the very nature of the bird fauna, depauperate with respect to the closely adjacent mainland (Appendix 1 shows there are no wrens or robins, only one, rare, thornbill and one honeyeater), suggests that much less movement between island and mainland takes place than might have been expected. Probably, therefore, many of the species found on the island are resident there. Mixed feeding flocks of the kind found throughout Australia (Gannon, 1934; Sedgwick, 1949) were not observed and most species, other than Silvereyes, seemed to remain within a small area. The underlying assumptions of the IPA method that the birds occur in a dispersed and not an aggregated pattern are, therefore, valid in this case, and the census results may be used as a baseline for comparison with future counts.

It is encouraging that the rankings of abundance derived from Atlas data agree well with that from the census methods, for data of this kind are now available for most of Australia.

There are, however, some special features of the Garden Island census work that need to be considered before they can be used to advocate widespread use of Atlas data as measures of abundance, and I am grateful to A. M. Gilmore for pointing these out to me. First, because Garden Island is an island the amount of emigration and immigration into the study area is limited. Secondly, avian density is less on islands than in continental areas and a greater intensity of sampling is needed reliably to rank the rare species in a continental area. Thirdly, Atlas data are often collected in a less standard way than was done during the Garden Island excursion. Often several people contribute their sightings to one sheet and usually sheets cover a longer time period than two days. Such variation would lead to substantial variation in the recording of rare species, although it should have little effect on the 'score' of common species. Nevertheless, the Garden Island results seem to justify further careful work to test the value of Atlas data in providing comparative abundance indices at least for those species of birds common or commonly seen in an area.

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